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ASSESSING THE PREDICTIVE ROLE OF LIPID PROFILE AND DIABETES MELLITUS PANEL ON FECAL INCONTINENCE SEVERITY

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ABSTRAK

Latar Belakang: Inkontinensia fekal (FI) adalah masalah umum di kalangan lansia yang secara signifikan mempengaruhi kualitas hidup mereka. Ini terkait dengan tantangan fisik dan psikologis. Disregulasi kadar glukosa dan lipid telah terlibat dalam FI, dengan obesitas dan hiperlipidemia berkontribusi pada peradangan sistemik dan kerusakan jaringan. Memahami faktor metabolik yang mempengaruhi FI dapat membantu dalam mengembangkan intervensi yang ditargetkan. **Tujuan:** Studi ini mengeksplorasi hubungan antara profil lipid, indikator diabetes mellitus, dan tingkat keparahan FI pada individu lanjut usia. **Metode:** Studi analitik cross-sectional dilakukan dengan 93 orang lanjut usia dari Panti Jompo Bina Bhakti. Indeks Keparahan Inkontinensia Fekal (FISI) digunakan untuk menilai keparahan FI. Profil lipid dan panel diabetes mellitus diperoleh melalui tes darah vena. Analisis statistik termasuk Spearman's Rho dan analisis regresi berganda. **Hasil:** Studi ini menemukan korelasi negatif yang signifikan antara kadar LDL dan keparahan FI, menunjukkan peran protektif LDL dalam menjaga integritas jaringan anorektal. Demikian pula, kadar HbA1c berhubungan terbalik dengan keparahan FI, menunjukkan bahwa kontrol glikemik yang lebih baik terkait dengan gejala FI yang berkurang. Parameter lipid dan indikator glikemik lainnya tidak menunjukkan dampak signifikan pada keparahan FI. **Kesimpulan:** Temuan ini menunjukkan bahwa manajemen lipid dan kontrol glikemik sangat penting dalam mengelola FI pada lansia. LDL dan HbA1c muncul sebagai penanda potensial untuk menilai risiko dan keparahan FI. Untuk meningkatkan hasil bagi pasien lanjut usia dengan FI, pendekatan multifaktorial, termasuk intervensi diet dan farmakologis, harus diprioritaskan.

Kata Kunci: Panel Diabetes Mellitus, Lansia, Inkontinensia Fekal, Profil Lipid

ABSTRACT

Background: *Fecal incontinence (FI) is a prevalent issue among the elderly, significantly impacting their quality of life. It is associated with both physical and psychological challenges. Dysregulation of glucose and lipid levels has been implicated in FI, with obesity and hyperlipidemia contributing to systemic inflammation and tissue damage. Understanding the metabolic factors influencing FI can aid in developing targeted interventions.* ***Objectives:*** *This study explores the relationship between lipid profiles, diabetes mellitus indicators, and the severity of FI in elderly individuals.* ***Methods:*** *A cross-sectional analytic study was conducted with 93 older adults from Bina Bhakti Nursing Home. The Fecal Incontinence Severity Index (FISI) was used to assess FI severity. Lipid profiles and diabetes mellitus panels were obtained through venous blood tests. Statistical analysis included Spearman's Rho and multiple regression analysis.* ***Results:*** *The study found significant negative correlations between LDL levels and FI severity, suggesting a protective role of LDL in maintaining anorectal tissue integrity. Similarly, HbA1c levels were inversely related to FI severity, indicating that better glycemic control is associated with reduced FI symptoms. Other lipid parameters and glycemic indicators showed no significant impact on FI severity.* ***Conclusion:*** *The findings suggest lipid management and glycemic control are crucial in managing FI in the elderly. LDL and HbA1c emerge as potential markers for assessing FI risk and severity. To improve outcomes for elderly*

patients with FI, a multifactorial approach, including dietary and pharmacological interventions, should be prioritized.

Keywords: *Diabetes Mellitus Panel, Elderly, Fecal Incontinence, Lipid Profile*

1. INTRODUCTION

Fecal incontinence (FI) is the inability to control the loss of solid or liquid stool and may severely affect quality of life. Physically, FI is linked to infection, ulceration, and skin scarring. Mentally, it is associated with social anxiety, behavioral issues, isolation, diminished self-esteem, and feelings of guilt and shame. Such difficulties deeply impact the quality of life. Fecal Incontinence is common in older adults, and a high prevalence of FI can be closely linked to overall health outcomes, including higher rates of illness and mortality (Jamieson et al., 2017; Saldana Ruiz and Kaiser, 2017). A wide variety of reasons, such as constipation with fecal impaction, excessive laxatives, diarrhea, cognitive impairment, aging-induced physical changes, and neurological conditions such as autonomic neuropathy, cause FI in older adults (Akhtar and Padda, 2005; Lumban Gaol et al., 2024). A recent review and meta-analysis of 80 studies with data from 548,316 people showed that FI is more common in those aged 60 years and above, and the global prevalence was 9.3% (95% CI, 6.6%–12.0%) compared to 4.9% (95% CI, 2.9%–6.9%) in younger people, which was almost double (Mack et al., 2024).

Regulating glucose and lipid levels is necessary to maintain anorectal function because any disturbances in these processes can cause FI. Obesity, which leads to FI in many cases, tends to coexist with hyperlipidemia, and many obese patients have elevated lipid levels. Dyslipidemia itself may worsen FI due to systemic and localized inflammation. Lipid peroxidation products can infiltrate tissues, causing an inflammatory response that damages the muscles and connective tissues needed to maintain continence. In addition, fatty acids deposited in the anorectal area might alter the local environment, causing fibrosis and decreasing tissue elasticity. Ultimately, this leads to impairment of the anal sphincter's mechanical function. These metabolic changes indicate that regulating glucose and lipid levels is necessary to prevent and treat FI, especially in susceptible populations (Andersen, 2022; Knowles et al., 2022; Stevens et al., 2003; Zhu et al., 2024).

In parallel, chronic hyperglycemia in patients with DM can produce AGEs, which can accumulate in tissues, including anorectal muscles. These AGEs can induce inflammation and oxidative stress, which result in tissue rigidity and fibrosis, thus damaging the integrity of the anal muscles and their ability to provide continence. Diabetes can also induce autonomic neuropathy, damaging the nerves that innervate rectal and anal muscles, leading to impaired muscle coordination and strength and decreased sphincter control. This neuropathy also affects the nerves that provide sensory feedback to rectal filling (Bharucha et al., 2015; Boland et al., 2013; Pedreanez et al., 2024).

There is limited research on lipid panels with diabetes mellitus panels and the severity of FI in the elderly population. As these metabolic measures could potentially identify early indicators of health issues and potential complications in older adults, this study sought to determine whether lipid levels or glucose values were related to the severity of FI in the elderly. Knowing these findings might help identify the severity of FI and its subsequent issues early. This could lead to better interventions for the elderly and help healthcare providers to produce better outcomes for their clients.

2. METHODS

The research design for this study was a cross-sectional analytic using 93 older adults as the sample, which were selected using total sampling from the residents at Bina Bhakti Nursing

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Home in 2024. The inclusion criteria used in this study were subjects at least 60 years of age who were willing to provide informed consent and allow blood to be taken. The exclusion criteria used for this study were subjects who had undergone major abdominal or colorectal surgery in the last year, were taking lipid-modifying or glucose metabolism-modifying medications (e.g. high-dose statins or insulin adjustments), had a severe mental illness that would risk participation or adherence to the study protocol, and could not be cooperative or did not understand the Indonesian language.

For this study, the independent variables include the severity of FI assessed by the Fecal Incontinence Severity Index (FISI) questionnaire. It is a well-validated questionnaire that evaluates symptoms of incontinence in the elderly, including four types: gas, mucus, liquid stool, and solid stool. The scores range from 0 to 61, with higher scores indicating more severe incontinence. The scores range from 0, which is no incontinence, to 61, which is severe incontinence. The dependent variables evaluated included the lipid profile and diabetes mellitus panels quantified and obtained through meticulously conducted venous blood tests with strict adherence to all normal protocols. The lipid profile includes triglycerides, total cholesterol, HDL, and LDL levels measured in mg/dL. In contrast, the diabetes panel includes fasting insulin (μU/mL), fasting glucose (mg/dL), HbA1c (%), and the HOMA-IR index, which provides a detailed evaluation of the metabolic profile.

The following software, SPSS version 26, was used to quantitatively analyze univariate and bivariate data. The Kolmogorov-Smirnov test determined the normality of data. For non-parametric correlation, we used Spearman's Rho test was used with a significance of $p<0.05$. Correlation strength ranges from negligible (0.00-0.10), weak (0.10-0.39), moderate (0.40-0.69), strong (0.70-0.89), and very strong (0.90-1.00). Respondent characteristics were based on means and standard deviations. Multiple regression analysis was used to determine the correlation between lipid profile and diabetes mellitus panel on the severity of fecal incontinence of the elderly. The most important output of the correlation is the unstandardized beta (B) value, which is the slope of the equation in which the predictor variable predicts the dependent variable.

3. RESULTS AND DISCUSSION

This study included 93 respondents, with females as the majority, and the average age of participants was 74.19 years (7.95). Lipid parameters included triglycerides at 100.39 mg/dL (29.51), total cholesterol at 160.19 mg/dL (29.27), high-density lipoprotein (HDL) averaging 44.69 mg/dL (12.11), and Low-density lipoprotein (LDL) levels were observed at 95 mg/dL (27.96). The average fasting insulin level was 4.83 μU/mL (1.8) while fasting glucose averaged 86.54 mg/dL (16.06). The mean HbA1c was 7.59% (1.41), and the average HOMA-IR was 1.03 (0.43). The Fecal Incontinence Severity Index (FISI) mean was 14.35 (±19.97). (Table 1)

Table 1. Respondent Characteristics

Parameter	Results (SD)
Age	74.19 (7.95)
Gender, %	
• Male	19 (20.4)
• Female	74 (79.6)
Triglycerides	100.39 (29.51)
Total Cholesterol	160.19 (29.27)
High-density lipoprotein (HDL)	44.69 (12.11)
Low-density lipoprotein (LDL)	95 (27.96)
Fasting Insulin	4.83 (1.8)

Parameter	Results (SD)
Fasting Glucose	86.54 (16.06)
HbA1c, %	7.59 (1.41)
HOMA-IR	1.03 (0.43)
Fecal Incontinence Severity Indeks (FISI)	14.35 (19.97)

In this study, the normality of the data distribution was assessed using the Kolmogorov-Smirnov test, which is well-suited for sample sizes of 50 or more. The analysis revealed that the distribution of all variables deviated from normality.

The FISI had a statistically significant correlation with some of the metabolics. The LDL showed a significant negative correlation with -0.236 of r-correlation and 0.023 of p-value, in which a high level of LDL is associated with less severity of fecal incontinence. The HbA1c had a significant negative correlation with an r-correlation of -0.218 and a p-value of 0.036, suggesting better long-term glycemic control is related to less severity of fecal incontinence. (Table 2)

Table 2. Correlation of Lipid Profile and Diabetes Mellitus Panel with Fecal Incontinence Severity

Parameter	*Fecal Incontinence Severity Index* (FISI)	
	r-correlation	p-value
Age	0,102	0,331
Triglycerides	-0,074	0,484
Total Cholesterol	-0,179	0,086
High-density lipoprotein (HDL)	0,114	0,277
Low-density lipoprotein (LDL)	-0,236	0,023*
Fasting Insulin	-0,005	0,959
Fasting Glucose	-0,071	0,496
HbA1c, %	-0,218	0,036*
HOMA-IR	-0,056	0,595

Further, the multiple regression analysis reveals that while age, triglycerides, total cholesterol, HDL, and LDL do not significantly impact FISI, HbA1c emerges as a key predictor. Thus, in the second model, HbA1c had a significant negative relationship with FISI ($p = 0.019$), indicating that higher HbA1c levels are associated with lower fecal incontinence severity. While fasting insulin, glucose, and HOMA-IR were trending, their relationship with FISI was not statistically significant. These results indicate that HbA1c should be monitored to manage fecal incontinence, while further investigation of other parameters may be needed. (Table 3)

Table 3. Multiple Regression of Lipid Profile and Diabetes Mellitus Panel on Fecal Incontinence Severity Index (FISI)

Parameter	Unstandardized Coefficient		Standardized Coefficient Beta	t	Sig
	B	Std. Error			
(Constant)	74.398	43.027		1.729	0.088
Age	0.078	0.281	0.031	0.278	0.781
Triglycerides	0.023	0.090	0.034	0.259	0.796
Total	-0.077	0.358	-0.113	-0.215	0.830

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Parameter	Unstandardized Coefficient		Standardized Coefficient	t	Sig
	B	Std. Error	Beta		
Cholesterol High-density lipoprotein (HDL)	0.188	0.385	0.114	0.488	0.627
Low-density lipoprotein (LDL)	-0.018	0.366	-0.026	-0.050	0.960
Fasting Insulin	-7.892	6.556	-0.714	-1.204	0.232
Fasting Glucose	-0.438	0.391	-0.352	-1.119	0.266
HbA1c, %	-3.176	1.706	-0.225	-1.862	0.066
HOMA-IR	36.551	30.403	0.792	1.202	0.233
(Constant)	40.441	11.092		3.646	0.000
HbA1c, %	-3.434	1.436	-0.243	-2.392	0.019

*Note: The dependent variable is the Fecal Incontinence Severity Index (FISI).

This study reveals significant correlations between low-density lipoprotein (LDL) levels and fecal incontinence (FI), suggesting a complex interaction where elevated LDL might link to protective mechanisms that mitigate FI severity. However, the exact pathways require further exploration. LDL's role in inflammatory processes and tissue repair is particularly notable, where LDL-induced acute inflammatory responses can trigger tissue repair and regeneration. In the anorectal region, this response may enhance the resilience of muscle and connective tissues, which is crucial for maintaining continence, by recruiting growth factors and cytokines that promote tissue remodelling and strengthen anorectal musculature. As the primary cholesterol transporter, LDL is vital for maintaining cell membrane integrity and fluidity. Cholesterol, a critical component of cell membranes, influences their permeability and function. In the anorectal region's nerve cells and muscle tissues, adequate cholesterol levels are essential for membrane stability, effective signal transmission, and muscle contraction and relaxation processes. This dual role of LDL in inflammation and membrane integrity suggests potential protective effects against FI. Meanwhile, HDL facilitates reverse cholesterol transport, removing excess cholesterol from tissues and preventing oxidative stress, which can damage anorectal tissues. HDL's anti-inflammatory properties reduce inflammation that might exacerbate FI, while its ability to improve endothelial function and enhance blood flow further supports tissue health in the anorectal area. This intricate balance of LDL and HDL roles underscores the complexity of lipid management in elderly patients with FI (Knowles et al., 2022; Malekmohammad et al., 2021; Potere et al., 2019; Song et al., 2022; Yu et al., 2024).

On the other hand, pro-inflammatory diets may initiate gastrointestinal inflammation, lead to an alteration of gut microbiome traits, and cause FI by disturbing neurosensory pathways. In addition, the renin-angiotensin system plays an essential role with the gut microbiota in linking gastrointestinal diseases to cardiovascular disease. The angiotensin-converting enzyme/angiotensin 1–7 system is essential in regulating immunity and the microbiota and, thus, GI disorders. Moreover, the proatherogenic effect of ANG II is due to the modification of cholesterol and foam cell formation, not the increase in serum cholesterol levels. ANG II increases the expression of ACAT1, transforming free cholesterol into esters stored in lipid droplets, promoting foam cell formation, and increasing cholesterol in atherosclerotic lesions.

Studies have reported that ANG II enhances the oxidation of LDL in macrophages, which may be due to the activation of NADPH oxidase (Li et al., 2024; Putnam et al., 2012; Yu et al., 2024).

In the Diabetes Mellitus Panel, HbA1c is correlated with FI. It may have an incremental predictive value, similar to the overall phenomenon of diabetic gastroenteropathy, which refers to the total impact of diabetes on the GI tract. The pathophysiology of diabetic gastroenteropathy is complex and incompletely understood. However, neuronal microenvironmental changes are believed to be key to diabetic pathophysiology. In patients with increased HbA1c and poor glucose control, chronic hyperglycemia and formation of AGEs result in oxidative stress and inflammation, which can lead to microvascular complications altering blood flow to the GI wall and microenvironment, resulting in diabetic neuropathy. This neuropathy can affect nearly all components of the ENS, including enteric neurons and ICs of Cajal, both of which are particularly vulnerable to hyperglycemia. A decrease in Cajal ICs can lead to smooth muscle myopathy from reduced trophic cues, leading to abnormal motility and gastroparesis. Diabetic pudendal neuropathy causing delayed PNTML leads to damage to the external anal sphincter and FI. Thus, genetic factors, chronic hyperglycemia, neuronal and microvascular changes, and smooth muscle dysfunction can recapitulate the pathophysiological pathway from increased HbA1c to FI in diabetic patients (Meldgaard et al., 2019; Uranga-Ocio et al., 2015; WATANABE et al., 2003).

This study has several limitations, including those that affect the interpretation of findings on lipid profiles, diabetes mellitus, and FI severity. The cross-sectional design does not permit for the elucidation of causality and only provides a current snapshot of associations. The study sample is limited to a single population, which may affect generalizability to other settings and/or populations. Confounding variables, e.g., diet, lifestyle, and other underlying conditions, were not adjusted for and may influence associations. Future longitudinal studies should explore causality and temporal relationships between lipids, glycemic control, and FI. Exploration of the effects of diet and lifestyle changes on lipid profile and FI outcomes may be warranted. Incorporation of other populations and settings would further increase generalizability. Elucidation of the underlying molecular mechanisms of lipids and diabetes causing FI could lead to new therapeutic targets and management strategies for FI patients with diabetes.

4. CONCLUSION

Regarding the relationship between lipid profiles, diabetes, and severity of FI, this study showed several potential mechanisms and interactions, as LDL may protect from anorectal tissue damage and dysfunction through its inflammatory and membrane-stabilizing effects. At the same time, HDL may further counteract the damaging effects of oxidative stress and inflammation. The balance between lipids may thus play an essential role in maintaining anorectal tissue health and is the guardian of severe FI in the elderly. In addition, the renin-angiotensin system and its interaction with the gut microbiome play an essential role in the interplay between the gastrointestinal and cardiovascular systems, which plays a critical role in FI. Pro-inflammatory diets modify the gut microbiome and may further aggravate FI. In addition, the HbA1c may further provide information about the severity of diabetic gastroenteropathy, and in chronic hyperglycemia, neuropathy and muscle damage may occur and further aggravate FI. Overall, this study found that the lipid profile and glycemic control treatment are essential aspects of treating FI in diabetic patients. This is an important aspect and should be considered in the management of FI. A multifactorial approach, including the use of diet and metabolic, as well as pharmacological treatment options, should be a priority.

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